Exercise - I (Conceptual Questions) Build Up Your Understanding

1. If $\vec{E}$ and $\vec{B}$ are the electric and magnetic field vectors of electromagnetic waves then the direction of propagation of electromagnetic wave is along the direction of –
(1) $\vec{E}$ (2) $\vec{B}$
(3) $\vec{E} \times \vec{B}$ (4) none of these

2. The electromagnetic waves do not transport -
(1) energy (2) charge
(3) momentum (4) information

3. The wave function (in S.I. units) for an electromagnetic wave is given as –
$\psi(x,t)=10^3 \sin\pi(3\times10^6 x-9\times10^{14} t)$
The speed of the wave is –
(1) 9×10^{14} m/s (2) 3×10^8 m/s
(3) 3×10^6 m/s (4) 3×10^7 m/s

4. In the above problem, wavelength of the wave is –
(1) 666 nm (2) 666 Å
(3) 666 μm (4) 6.66 nm

5. In an electromagnetic wave the average energy density is associated with –
(1) electric field only
(2) magnetic field only
(3) equally with electric and magnetic fields
(4) average energy density is zero

6. In an electromagnetic wave the energy density associated with magnetic field will be
(1) $\frac{1}{2}LI^2$ (2) $\frac{B^2}{2\mu_0}$
(3) $\frac{1}{2}\mu_0 B^2$ (4) $\frac{1}{2}\frac{\mu_0}{B^2}$

7. In the above problem, the energy density associated with the electric field will be –
(1) $\frac{1}{2}CV^2$ (2) $\frac{1}{2}\frac{q^2}{C}$
(3) $\frac{1}{2}\frac{\varepsilon^2}{E}$ (4) $\frac{1}{2}\varepsilon_0 E^2$

8. If there were no atmosphere, the average temperature on earth surface would be –
(1) lower (2) higher
(3) same (4) 0° C

9. In which part of earth's atmosphere is the ozone layer present?
(1) troposphere (2) stratosphere
(3) ionosphere (4) mesosphere

10. The ozone layer is earth's atmosphere is crucial for human survival because it –
(1) contains ions
(2) reflects radio signals
(3) reflects ultraviolet rays
(4) reflects infrared rays

11. The frequency from 3×10^9 Hz to 3×10^{10} Hz is –
(1) high frequency band
(2) super high frequency band
(3) ultra high frequency band
(4) very high frequency band

12. The frequency from 3MHz to 30 MHz is known as –
(1) audio band
(2) medium frequency band
(3) very high frequency band
(4) high frequency band

13. The AM range of radiowaves have frequency –
(1) less than 30 MHz
(2) more than 30 MHz
(3) less than 20000Hz
(4) more than 20000Hz

14. Select wrong statement from the following for EMW-
(1) are transverse
(2) travel with same speed in all medium
(3) travel with the speed of light
(4) are produced by accelerating charge

15. The waves related to tele-communication are -
(1) infrared (2) visible light
(3) microwaves (4) ultraviolet rays

16. The nature of electromagnetic wave is –
(1) longitudinal
(2) longitudinal stationary
(3) transverse
(4) transverse stationary

TG: @Chalnaayaaar

17. Greenhouse effect keeps the earth surface –
(1) cold at night (2) dusty and cold
(3) warm at night (4) moist

18. The speed of electromagnetic radiation in vacuum is :-
(1) $\mu_0\varepsilon_0$ (2) $\sqrt{\mu_0\varepsilon_0}$
(3) $\frac{1}{\mu_0\varepsilon_0}$ (4) $\frac{1}{\sqrt{\mu_0\varepsilon_0}}$

19. What is the cause of greenhouse effect?
(1) Infrared rays (2) Ultraviolet rays
(3) X-rays (4) Radio waves

20. The conduction current is the same as displacement current when source is :-
(1) ac only (2) dc only
(3) both ac and dc (4) neither dc nor ac

EXERCISE-I (Conceptual Questions) ANSWER KEY

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer	3	2	2	1	3	2	4	1	2	3	2	4	1	2	3
Question	16	17	18	19	20										
Answer	3	3	4	1	3										

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Exercise - II (Previous Year Questions) AIPMT/NEET

AIPMT 2009

1. The electric field part of an electromagnetic wave in a medium is represented by $E_x = 0$;

$$E_y = 2.5\frac{N}{C}\cos\left[\left(2\pi\times10^6\frac{rad}{s}\right)t-\left(\pi\times10^{-2}\frac{rad}{m}\right)x\right]$$

$E_z = 0$. The wave is :

(1) Moving along –x direction with frequency 10^6 Hz and wavelength 200 m.

(2) Moving along y direction with frequency $2\pi \times 10^6$ Hz and wavelength 200 m.

(3) Moving along x direction with frequency 10^6 Hz and wavelength 100 m.

(4) Moving along x direction with frequency 10^6 Hz and wavelength 200 m.

AIPMT (Pre) 2010

2. Which of the following statement is false for the properties of electromagnetic waves?

(1) These waves do not require any material medium for propagation

(2) Both electric and magnetic field vectors attain the maxima and minima at the same place and same time

(3) The energy in electromagnetic wave is divided equally between electric and magnetic vectors

(4) Both electric and magnetic field vectors are parallel to each other and perpendicular to the direction of propagation of wave

AIPMT (Pre) 2011

3. The dimensions of $(\mu_0\in_0)^{-1/2}$ are :

(1) $[L^{1/2}T^{-1/2}]$ (2) $[L^{-1}T]$

(3) $[LT^{-1}]$ (4) $[L^{-1/2}T^{1/2}]$

4. The electric and the magnetic field, associated with an e.m. wave, propagating along the +z-axis, can be represented by :-

(1) $\left[\vec{E}=E_0\hat{i},\vec{B}=B_0\hat{j}\right]$ (2) $\left[\vec{E}=E_0\hat{k},\vec{B}=B_0\hat{i}\right]$

(3) $\left[\vec{E}=E_0\hat{j},\vec{B}=B_0\hat{i}\right]$ (4) $\left[\vec{E}=E_0\hat{j},\vec{B}=B_0\hat{k}\right]$

5. The decreasing order of wavelength of infrared, microwave, ultraviolet and gamma rays is :

(1) microwave, infrared, ultraviolet, gamma rays

(2) gamma rays, ultraviolet, infrared, microwaves

(3) microwaves, gamma rays, infrared, ultraviolet

(4) infrared, microwave, ultraviolet, gamma rays

AIPMT (Pre) 2012

6. The electric field associated with an e.m. wave in vacuum is given by $\vec{E} = 40\cos(kz - 6\times10^8t)$, where E, z and t are in volt/m, meter and seconds respectively. The value of wave vector k is :

(1) $6m^{-1}$ (2) $3m^{-1}$ (3) $2m^{-1}$ (4) $0.5m^{-1}$

NEET-UG 2013

7. The condition under which a microwave oven heats up a food item containing water molecules most efficiently is :-

(1) Infra-red waves produce heating in a microwave oven

(2) The frequency of the microwaves must match the resonant frequency of the water molecules

(3) The frequency of the microwaves has no relation with natural frequency of water molecules

(4) Microwaves are heat waves, so always produce heating

Re-AIPMT 2015

8. The energy of the em waves is of the order of 15 keV. To which part of the spectrum does it belong?

(1) γ-rays (2) X-rays

(3) Infra-red rays (4) Ultraviolet rays

AIPMT 2015

9. A radiation of energy 'E' falls normally on a perfectly reflecting surface. The momentum transferred to the surface is (c = Speed of light) :-

(1) $\frac{2E}{c}$ (2) $\frac{2E}{c^2}$ (3) $\frac{E}{c^2}$ (4) $\frac{E}{c}$

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NEET-I 2016

10. Out of the following options which one can be used to produce a propagating electromagnetic wave?

(1) A charge moving at constant velocity

(2) A stationary charge

(3) A chargeless particle

(4) An accelerating charge

11. A 100 Ω resistance and a capacitor of 100 Ω reactance are connected in series across a 220 V source. When the capacitor is 50% charged, the peak value of the displacement current is :-

(1) 4.4 A (2) $11\sqrt{2}$ A

(3) 2.2 A (4) 11 A

NEET (UG) 2017

12. In an electromagnetic wave in free space the root mean square value of the electric field is E_{rms} = 6V/m. The peak value of the magnetic field is :-

(1) 2.83×10^{-8} T (2) 0.70×10^{-8} T

(3) 4.23×10^{-8} T (4) 1.41×10^{-8} T

NEET (UG) 2018

13. An em wave is propagating in a medium with a velocity $\vec{V} = V\hat{i}$. The instantaneous oscillating electric field of this em wave is along +y axis. Then the direction of oscillating magnetic field of the em wave will be along :-

(1) –z direction (2) +z direction

(3) –y direction (4) –x direction

NEET (UG) 2019 (Odisha)

14. For a transparent medium relative permeability and permittivity, μ_r and $\in_r$ are 1.0 and 1.44 respectively. The velocity of light in this medium would be,

(1) 2.5×10^8 m/s (2) 3×10^8 m/s

(3) 2.08×10^8 m/s (4) 4.32×10^8 m/s

TG: @Chalnaayaaar

NEET (UG) 2020

15. Light with an average flux of 20 W/cm² falls on a non-reflecting surface at normal incidence having surface area 20 cm². The energy received by the surface during time span of 1 minute is :

(1) 48×10^3 J (2) 10×10^3 J

(3) 12×10^3 J (4) 24×10^3 J

16. The ratio of contributions made by the electric field and magnetic field components to the intensity of an electromagnetic wave is :

(c = speed of electromagnetic waves)

(1) 1 : c^2 (2) c : 1

(3) 1 : 1 (4) 1 : c

NEET (UG) 2020 (COVID-19)

17. The E.M. wave with shortest wavelength among the following is

(1) Ultraviolet rays (2) X-rays

(3) Gamma-rays (4) Microwaves

18. The magnetic field in a plane electromagnetic wave is given by :

$B_y = 2 \times 10^{-7} \sin(\pi \times 10^3 x + 3\pi \times 10^{11} t)$T

Calculate the wavelength.

(1) $\pi \times 10^3$ m (2) 2×10^{-3} m

(3) 2×10^3 m (4) $\pi \times 10^{-3}$ m

NEET (UG) 2021

19. A capacitor of capacitance 'C', is connected across an ac source of voltage V, given by $V = V_0 \sin \omega t$. The displacement current between the plates of the capacitor, would then be given by :

(1) $I_d = V_0 \omega C \cos\omega t$ (2) $I_d = \frac{V_0}{\omega C}\cos\omega t$

(3) $I_d = \frac{V_0}{\omega C}\sin\omega t$ (4) $I_d = V_0 \omega C \sin\omega t$

20. For a plane electromagnetic wave propagating in x-direction, which one of the following combinations gives the correct possible directions for electric field (E) and magnetic field (B) respectively?

(1) $\hat{j}+\hat{k}, \hat{j}+\hat{k}$ (2) $-\hat{j}+\hat{k}, -\hat{j}-\hat{k}$

(3) $\hat{j}+\hat{k}, -\hat{j}-\hat{k}$ (4) $-\hat{j}+\hat{k}, -\hat{j}+\hat{k}$

TG: @Chalnaayaar

NEET (UG) 2022

21. When light propagates through a material medium of relative permittivity ε_r and relative permeability μ_r, the velocity of light, v is given by : (c = velocity of light in vacuum)

(1) $v = \sqrt{\frac{\mu_r}{\varepsilon_r}}$ (2) $v = \sqrt{\frac{\varepsilon_r}{\mu_r}}$

(3) $v = \frac{c}{\sqrt{\varepsilon_r \mu_r}}$ (4) $v = c$

22. Match List - I with List -II

List -I (Electromagnetic waves)		List-II (Wavelength)	
(a)	AM radio waves	(i)	10^{-10} m
(b)	Microwaves	(ii)	10^{2} m
(c)	Infrared radiations	(iii)	10^{-2} m
(d)	X-rays	(iv)	10^{-4} m

Choose the correct answer from the options given below :

(1) (a) - (iii), (b) - (ii), (c) - (i), (d) - (iv)

(2) (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)

(3) (a) - (ii), (b) - (iii), (c) - (iv), (d) - (i)

(4) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)

RE-NEET (UG) 2022

23. The magnetic field of a plane electromagnetic wave is given by

$\vec{B} = 3\times10^{-8}\cos(1.6\times10^{3}x + 48\times10^{10}t)\hat{j}$, then the associated electric field will be :

(1) $3\times10^{-8}\cos(1.6\times10^{3}x + 48\times10^{10}t)\hat{i}\,V/m$

(2) $3\times10^{-8}\sin(1.6\times10^{3}x + 48\times10^{10}t)\hat{i}\,V/m$

(3) $9\sin(1.6\times10^{3}x - 48\times10^{10}t)\hat{k}\,V/m$

(4) $9\cos(1.6\times10^{3}x + 48\times10^{10}t)\hat{k}\,V/m$

24. The ratio of the magnitude of the magnetic field and electric field intensity of a plane electromagnetic wave in free space of permeability μ_0 and permittivity ε_0 is

(c - velocity of light in free space)

(1) c (2) $\frac{1}{c}$

(3) $\frac{c}{\sqrt{\mu_0\varepsilon_0}}$ (4) $\frac{\sqrt{\mu_0\varepsilon_0}}{c}$

EXERCISE-II (Previous Year Questions) ANSWER KEY

Question	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Answer	4	4	3	1	1	3	2	2	1	4	3	1	2	1	4
Question	16	17	18	19	20	21	22	23	24						
Answer	3	3	2	1	2	3	3	4	2						

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Exercise – III (Analytical Questions) Master Your Understanding

1. For EM waves

(a) γ rays have higher penetrating power than x rays

(b) x rays have higher penetrating power than γ rays

(c) Infrared has higher wavelength than x-rays

(d) Range of visible light is 4000 Å to 7000 Å

then correct options are

(1) a, b and d (2) a, c and d

(3) a and c (4) a, b and d

2. Electric field associated with EM wave in free space is given by $\vec{E}=30\sin\left(6\times10^8 t+kz\right)\hat{i}$ then match the following columns.

	Column-I		Column-II
(a)	Direction of propagation of EM wave	(p)	–y axis
(b)	Wave length of EM wave	(q)	2 m^{-1}
(c)	Direction of magnetic field of EM wave	(r)	3.14 m
(d)	Propagation constant 'k' of EM wave	(s)	'–z' axis

(1) a-p, b-r, c-s, d-r (2) a-s, b-r, c-p, d-q

(3) a-p, b-q, c-s, d-s (4) a-s, b-r, c-p, d-p

3. Given below are two statements: one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A) : MRI is less harmful medical diagnosis technique than CT-scan

Reason (R) : X-rays are used in CT-scan, while MRI uses radio waves.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**.

(2) Both **(A)** and **(R)** are true and **(R)** is NOT the correct explanation of **(A)**.

(3) **(A)** is true but **(R)** is false.

(4) **(A)** is false but **(R)** is true.

4. **Match the column I with column II -**

	Column-I (Law)		Column-II (Mathematical formula)
(A)	Faraday law	(P)	$\oint\vec{E}.d\vec{A}=\frac{q}{\epsilon_0}$
(B)	Ampere Maxwell law	(Q)	$\oint\vec{B}.d\vec{A}=0$
(C)	Gauss law for magnetism	(R)	$\oint\vec{E}.d\vec{\ell}=-\frac{d\phi_B}{dt}$
(D)	Gauss law for electrostatics	(S)	$\oint\vec{B}.d\vec{\ell}=\mu_0 i+\epsilon_0\mu_0\frac{d\phi_E}{dt}$

Options :-

(1) A → R, B → Q, C → S, D → P

(2) A → P, B → Q, C → S, D → R

(3) A → P, B → S, C → Q, D → R

(4) A → R, B → S, C → Q, D → P

EXERCISE-III (Analytical Questions) ANSWER KEY

Question	1	2	3	4
Answer	2	2	1	4

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